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Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the matter of	)
	)
AN INQUIRY INTO THE COMMISSIONS POLICIES AND RULES REGARDING AM RADIO SERVICE DIRECTIONAL ANTENNA PERFORMANCE VERIFICATION	) MM Docket No. 93-177) RM-7594))

To: The Commission

COMMENTS OF
POTOMAC INSTRUMENTS, inc.

Directional AM antenna arrays have facilitated a quality and diversity of AM service, in the United States, that is unmatched by government or commercial AM broadcast services anywhere in the world. Potomac Instruments (PI) and its antecedents have devoted nearly fifty years of continual effort toward the design, development, and manufacture of instruments for monitoring AM directional antenna array parameters. We endorse the actions of the petitioners and the Commission which have resulted in the subject Notice of Inquiry. The NOI is both appropriate and timely because it initiates a much needed dialog between a vital segment of a closely regulated industry and its regulators. Having supplied a vast majority of the Antenna Monitors and Field Strength Meters employed for AM directional service around the world, PI believes that it has a unique perspective of the day-to-day problems associated with this aspect of the technology.

Antenna Monitors: Major Points and Recommendations

1. Repeatability most important: The Antenna Monitor is used to observe deviations of directional antenna current ratios and relative phases from the values of these parameters set at the initial proof of performance. It follows that the most important characteristics of a monitor are the stability and repeatability of its indications over long time periods, since we want to know that any deviation observed is due to array drift rather than monitor (or sampling system) drift. Detailed FCC Rule requirements for monitor installation, performance, and calibration should therefore be directed toward insuring repeatability.

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2. <u>The "Precision" Monitor and its problems:</u> Sec. 73.69(a) calls for a monitor to be authorized on an individual basis when the station authorization sets specific tolerances for current ratio and phase. Presumably this would be done when tolerances tighter than the ±5% for ratio and ±3° for phase of Sec. 73.62 are needed. Such a monitor has been generally referred to as a precision monitor; the Sec. 73.14 definition of a "Critical directional antenna" refers to a "high precision monitor". In practice, for the past 20-odd years the monitor used in nearly all such cases has been the Potomac PM-19 System. In the PM-19, greater precision in ratio measurement results from using a so-called deviation circuit, in which the deviation of ratio from a preset value is measured, independent of modulation effects. Because of this, specifying a "precision monitor" has come to mean specifying a monitor using the deviation circuit for ratio monitoring.

Four factors reflecting current real-world conditions call for a change in the situation just described. The first is the high cost of manufacture of the PM-19, due to the small product volume (approximately 30 Systems have been delivered in a period of 24 years) and to the obsolescence of many of the parts used in it. Second is that a new design for the "precision" application only, using modern components, cannot be justified on the basis of economics, again because of the small sales volume, especially in view of the third factor; this is, that current technology allows equivalent precision in ratio measurement without using the deviation circuit, at much lower cost to the station than the PM-19 System. Fourth is that because the PM-19 System requires making manual adjustments to take a reading with maximum precision, it is difficult to use in combination with a remote control system. It is therefore an obstacle to efficient station operation.

3. <u>Current Monitor technology</u>: Use of modern analog and digital components in Potomac's current "standard" monitor, the 6th generation of the Nems-Clarke / Potomac Instruments lineage of Antenna Monitors which was authorized by the FCC in 1991, has made it possible to design circuits to measure current sample ratio directly with no fluctuation due to compound modulation schemes such as that used for AM stereo. The stability and repeatability depends mainly on the stability of passive components, thus duplicating one of the virtues of the old deviation circuit of the PM-19. The type of phase-reading circuit used in several recent monitors, including the PM-19 system, has been found adequate for "precision" applications. It is still used in today's monitor, with the addition of phase sign circuitry which allows for remote reading of the sign along with the value of the angle.

Tests have shown, and field experience is indicating, that the current standard monitor is a stable element in the monitoring system, and as confidence in it is gained there seems little reason to continue to require that a monitor for a tight-tolerance directional antenna be equipped with deviation circuits.

4. <u>Monitor Calibration</u>: For the Antenna Monitor there has been no prescribed field calibration method or interval. When unexpected changes occur in the monitor indication, however, a station may well wish to be able to check the repeatability of its monitor without removing the unit from its rack and returning it to the manufacturer. This can be done very simply if at initial installation, ratio and phase standards are prepared. At its simplest the standard can be a passive component to be connected between the reference RF input and any other input, using the reference tower current sample as the test signal. It could consist of a length of coaxial cable cut to give a phase shift close to the normal tower phase, plus a resistive attenuator to give a ratio value close to the normal tower ratio. Readings would be taken at monitor installation with this standard in place; the standard and a record of its readings would then be carefully maintained. At any future time the standard can be inserted and readings taken, which should be very close to the initial readings if there is no monitor problem.

If a more comprehensive field calibration is desired, a calibration source could be devised which would supply test signals to the monitor at a number of phase and ratio values throughout the measurement range. Such a device would check accuracy as well as repeatability.

5. <u>Detailed Monitor Specifications</u>: Rules Sec. 73.53 contains detailed specifications which an antenna monitor must meet to be eligible for FCC authorization; this is by grant of notification as prescribed in Rules Part 2, Subpart J. Of all the instruments important to proper operation of a radio station, the antenna monitor is the only one specified in such detail. Sec. 73.53 is complete enough to be used as a purchase specification -- but, the monitor purchased this way would be a 1960s monitor if every detail were complied with. In particular, 73.53(b)(7) calls for a switching arrangement in a monitor for a multi-tower antenna which is not the only satisfactory way to design such a monitor. This requirement had roots in history prior to the time of its writing in the late 60s, but is no longer appropriate. It is certainly desirable, however, that monitors be held to a high standard of performance of their essential function. The question is, must this be done by detailed specifications in the Rules, or, is there another way to do it?

A comparison might be made with another instrument essential to directional antenna performance measurement, the Field Strength Meter. The Rules contain no specifications for it, yet it has maintained a high standard of accuracy, repeatability, and reliability. The reasons for this include, first, the manufacturer's wish to market a product which meets the more demanding user's requirements with a minimum of service after purchase; second, specifications prepared by the FCC for purchase of instruments for its own use, based on the manufacturer's best capability; third, the constant intercomparison of units in the field when several are used in a measurement; and fourth, meter recalibration by the manufacturer and by the FCC. For the antenna monitor, the first certainly applies; the second has not occurred, although with 73.53 it could have; the third does not occur except in a very few cases; the fourth does occur when a monitor's accuracy is questioned and it is returned to the manufacturer for a calibration check.

Another question is, what degree of precision and repeatability is really needed for directional antenna monitoring? It would be useful to have the comments of experienced antenna designers on this point -- how much variation in any one ratio or phase of a given design does it take to produce a significant pattern change? It would seem that modern computer analysis could provide such information.

<u>Recommendations</u>: Retain Sec. 73.53 but whittle it down to the performance specifications which are essential to the basic function of the monitor. Simply stated, this means requiring that the monitor meet specifications for accuracy and repeatability under all conditions of modulation present, throughout the range of ambient environmental conditions the monitor will encounter in operation. The specifications for repeatability could be tightened enough to cover the requirements of critical directional antennas; this would eliminate the need to refer in the Rules to a precision monitor for which there are no specifications. An alternative would be to have in 73.53, two different levels of the whittled-down specifications, a tighter one for use with the most parameter-sensitive arrays and a looser one for use with less critical arrays. In either case there will be a performance requirement to cover all monitors, which seems more rational than the present situation. This will allow for the graceful demise of the PM-19 System as the only monitor for critical arrays.

As for design features such as compatibility with remote control systems, they need not be included in 73.53. If users require such features for efficient operation, manufacturers will feel the market pressure and will develop them without the FCC having to require them.

It seems reasonable to replace requirements on remote indicating devices for monitors with a general requirement to cover all telemetering equipment in the station, including remote control systems. The requirement would be that such equipment display data without degradation of precision and repeatability from that of the originating device. This sort of requirement, however, amounts to requiring what is obvious good engineering practice, and leads to the general question, to what extent is it necessary to include in the Rules, items which are obvious good engineering practice?

With regard to field calibration of monitors as discussed in (4) above, although maintaining a calibrating device at the station would be good insurance, it is questionable whether there is any advantage to requiring that all stations do this. It is perhaps best left as an option which stations with greater engineering resources may wish to pursue.

<u>Field Strength Measurements:</u>

Sophisticated computer modeling has provided a means of predicting directional AM antenna patterns with an accuracy that is vastly superior to previous modeling methods. In fact, it is fair to say that, if a new antenna array is designed by a knowledgeable engineer using one of these modeling programs, if all design variables are known, and if the array is constructed according to design parameters, in an unobstructed area, there would probably be very little need to verify antenna performance beyond a close monitoring of the physical construction project. Under these circumstances we would support the argument that full proofs, partial proofs, and to a lesser extent, skeleton proofs may be burdensome and unnecessary.

However, since most of the AM antenna arrays (and associated antenna tuning networks) in use today are not new and many of these arrays are no longer in unobstructed areas, it would be difficult to extend the logical argument that performance of the array could be accurately predicted unless that prediction is confirmed, to some extent, by actual physical measurements.

The antenna pattern(s) of an AM directional antenna array can be accurately verified by continuously monitoring the relative phases and amplitudes of the currents of the individual elements in the array and by reconciling that data via periodic field strength measurements at designated monitoring points. Even a well maintained array is subject to pattern distortion if a passive radiator (crane, tower, building, guard rail, etc.) is erected at a location in which the object becomes an unwanted parasitic element of the antenna array. Absent sufficient field strength measurement data to clearly define the station's pattern(s), it would be extremely difficult for a licensee to prove any deleterious pattern effects resulting from a new structure.

We doubt that an uncooperative owner of a newly constructed passive radiator could be forced to de-tune the interfering object on the basis of pattern predictions that are based upon theoretical computer modeling.

In situations where a station has undergone major modifications or is being re-commissioned after having been "dark" for a period of time or has operated for extended periods under Special Test Authority, we believe that good engineering practice would dictate that sufficient field strength measurement data would be collected to, at least, confirm coverage of the station's primary service area and to insure compliance with the interference protection ratios established by the station's Instrument of Authorization. Because of variations in measurement site accessibility, perhaps the licensee should be afforded some latitude in the selection of the station's monitor points. An engineering exhibit could be used to justify the need for relocating the monitor point(s) and to provide the rationale for the selection of the new monitor point(s). In this way, the commission could relax the rigid and burdensome measurements requirements that require "N" points on each radial for every antenna array regardless of whether that array is located in the Everglades or the Rockies.

Remote Control Operations

Remote Control Systems manufacturers have provided an excellent assortment of automatic data acquisition instruments that are capable of detecting, alarming, and logging out of tolerance antenna parameters derived from the station's antenna monitor. Some of these systems also provide calendar and clock related databases which provide capabilities for automatic pattern switching at designated times.

Because of the plethora of remote control devices on the market, because of the "soft" interpretation of what the rules require for remotely controlled stations, because operator logs are no longer required, and because engineering, in general, and test and monitoring equipment, specifically, is relegated to a very low priority in the capital equipment budget of all but the best of the AM directional stations, we would submit that there are no functional standards for broadcast remote control. Certain group owners with strong engineering departments and certain individual licensees have automated their facilities and are operating their stations with the same diligence that was required before the radio De-Regulation era. However, our observations tell us that these stations are in the minority.

PI opposes a return to the philosophy that good engineering practice should be dictated by detailed regulations. But, we also believe that a failure to detect and correct potential causes of interference jeopardizes the viability of an entire broadcast service. Accordingly, we would suggest that the Commission to consider a ruling which would require remotely controlled AM Directional licensees to either provide an means for providing antenna parameter tolerance alarms and automatic pattern switching or, alternatively, to maintain an operating log for the purpose of ensuring that the antenna array is properly monitored and steered.

Operator Technical Expertise

Some of the problems that we have encountered in recent customer service contacts would imply that, because of a lack of technically qualified personnel, there may be a number of stations with undetected physical deterioration of towers, phasors, antenna sampling systems, ground systems, monitoring instruments and antenna sites. Since each one of these situations represents a potential cause of harmful interference, we believe that it may be prudent for the Commission to revisit, in this proceeding, the question of minimum technical qualifications of designated Chief Operators at stations employing complex antenna arrays.

In our opinion, it would not be necessary to reinstate a Federal operator licensing policy to ensure technical competence. The National Association of Broadcasters (NAB) and the Society of Broadcast Engineers (SBE) are examples of industry organizations that have developed technical training courses relating to the theory and maintenance of AM directional antennas. Therefore, it would seem appropriate that both the operators who are charged with the responsibility for maintaining multi-element antenna arrays and the FCC field personnel who are charged with the responsibility for inspecting those arrays should have demonstrated a minimum level of understanding of the subject by successfully completing one of these courses or by means of equivalent job related experience.

Respectfully Submitted,

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